

Prebiotic Supplementation with Partially Hydrolyzed Guar Gum and Inulin Improves Bowel Habits and Gut Functional Markers: A Case Series Study

Vania Mattoso Ribeiro¹, Ana Beatriz Baptistella², Silvana Paiva Orlandi³, Katherine Guerra⁴,
Nathalia Laganaro⁴, Valeria Abrahao Schilling Rosenfeld^{4,*}

¹Federal University Fluminense, Brazil

²Independent Researcher, Brazil

³Postgraduate Program in Nutrition and Foods, University Hospital/EBSERH, Federal University of Pelotas, Brazil

⁴Nestle Health Science, Brazil

ABSTRACT

Prebiotic fibers play a crucial role in regulating intestinal motility and contribute to improvements in gastrointestinal symptoms associated with altered transit and fermentative activity. The aim of this exploratory case series was to evaluate the effects of a fiber blend containing inulin and partially hydrolyzed guar gum on bowel habits, gastrointestinal symptoms, and biochemical markers in adults reporting constipation and/or diarrhea. Two women received supplementation for 36 days, including a 6-day ramp-up phase until reaching 22g/day. Clinical symptoms, stool characteristics, biochemical markers, and functional stool parameters were assessed at baseline and post-intervention. Both cases showed improvements in bowel frequency and/or stool consistency, with progression on the Bristol Stool Form Scale. Reductions were observed in fecal calprotectin, zonulin, and fecal fat, suggesting improved intestinal inflammatory status and digestive function. Systemic metabolic and hepatic biomarkers remained stable, reinforcing the safety of the intervention. These findings support the potential benefits of prebiotic fiber supplementation for bowel function and gut-related biomarkers, warranting further studies with larger samples.

Keywords: Gut Health, Constipation, Soluble Fiber, Prebiotic Fiber Supplementation.

ABBREVIATIONS

WHO: World Health Organization; DF: Dietary Fiber; MIF: Formalin Embedding Medium; ESR: Erythrocyte Sedimentation Rate; SGOT: Glutamic Oxaloacetic Transaminase; SGPT: Glutamic Pyruvic Transaminase; GGT: Gamma-Glutamyl Transpeptidase; TSH: Thyroid-Stimulating Hormone; CRP: C-Reactive Protein; TMAO: Trimethylamine N-Oxide.

INTRODUCTION

The World Health Organization (WHO) defines dietary fiber (DF) as complex carbohydrates that are neither digested nor absorbed in the

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*Corresponding Author

Valeria Abrahao Schilling Rosenfeld,

Nestle Health Science, São Paulo,
Brazil, ORCID: 0000-0003-2372-9649,
Email: Valeria.Rosenfeld@br.nestle.com

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small intestine, reaching the large intestine intact. These components contribute to the regulation of digestion and bring several health benefits [1,2]. Epidemiological studies have consistently demonstrated the positive effects of dietary fiber on gastrointestinal health, especially from whole foods, which exert beneficial effects on the gastrointestinal tract and microbiota and have therapeutic potential in gastrointestinal disorders [3].

Dietary fibers, present mainly in foods of plant origin, are classified as soluble and insoluble. Soluble fibers have viscous properties and are fermented by bacteria in the colon, which contributes to adequate intestinal transit and reduces pH, in addition to generating by-products with beneficial local and systemic effects. These fibers are considered prebiotics because they serve as substrates for bacterial fermentation, promoting a favorable composition and metabolic activity of the intestinal microbiota [4,5]. Insoluble fibers, in turn, mainly perform the function of increasing the volume of the fecal bolus, facilitating elimination [6].

The gut microbiota is a complex ecosystem of bacteria, fungi, viruses, and protozoa that colonize the intestine. Fermentation produces byproducts, such as short-chain fatty acids, which benefit digestive, immune, and metabolic health. Diets rich in vegetables and dietary fiber promote a diverse and healthy microbiota, but prebiotic fiber supplementation may be necessary to achieve the optimal amount of DF, favoring immune and metabolic responses [7-9].

In addition, prebiotic fibers in the individual's diet, intestinal transit time is another factor that affects the composition and diversity of the microbiota [10]. Intestinal transit time depends on intestinal motility, which determines the characteristics of feces during the evacuation process and aims to eliminate undigested and unabsorbed food constituents, as well as cells and components of the microbiota. A bowel movement frequency between three times a week and three times a day is considered "normal". Thus, a change in this pattern is recognized as a gastrointestinal complication and can be grouped into constipation, diarrhea, or irritable bowel syndrome [11].

Constipation is defined by reduced frequency of bowel movements, lumpy or hard stools, and a sensation of incomplete evacuation [12]. The prevalence ranges from 7% to 10%, and is higher in women [11,12]. The pathophysiology of this disorder is not yet fully understood, but it is multifactorial influenced by age, sex, medication use, comorbidities, and lifestyle factors, such as insufficient hydration, inadequate nutrition, and low physical activity [13,14]. Among the main recommendations for management increased in dietary fiber intake [6,13,15].

Like constipation, chronic diarrhea, characterized by increased bowel movement frequency and reduced stool consistency for more than four weeks, can occur for different reasons, such as medications and surgical procedures, structural changes in the intestine, secondary to diseases, irritable bowel syndrome, malabsorption, infections, and microbiota imbalances, among others [16,17]. The prevalence in adults ranges from 3% to 5%, and it is difficult to diagnose due to multiple primary or secondary causes [18].

Prebiotic fiber supplementation can significantly benefit health and intestinal microbiota, acting directly as a substrate and indirectly by improving intestinal function [6]. Among the prebiotics studied for this purpose are inulin and partially hydrolyzed guar gum.

Inulin, a fructan present in fruits and vegetables such as wheat, onion, banana, garlic, artichoke, chicory, and leek, favors the colonic environment by stimulating the growth of beneficial bacteria and improving intestinal function, helping to reduce cases of constipation [19,20]. Similarly, partially hydrolyzed guar gum, extracted from the seeds of *Cyamopsis tetragonolobus*, promotes the production of bacterial byproducts and also improves intestinal function. This supplement is safe and effective in optimizing metabolic and intestinal parameters, benefiting both cases of constipation and diarrhea [21,22].

Therefore, given the evidence on the efficacy of prebiotics, this study aims to evaluate the effects of supplementation with a fiber mixture containing guar gum and inulin on intestinal motility in individuals with complaints of constipation and/or diarrhea. Improvements in gastrointestinal symptoms will be analyzed, along with markers of intestinal health and biochemistry, including inflammation, liver function, thyroid function, and nutrient levels.

MATERIALS & METHODS

Study design and participants

This is a series of two cases in which the effects of supplementation with a fiber mix (Fiber Mais® Suco Verde) on the intestinal motility of women with a history of constipation were evaluated. After selection participants underwent a Merthiolate-Iodine-Formalin (MIF) parasitological exam to rule out intestinal parasites, a condition that can directly interfere with the protocol's application.

Application of the protocol

The supplementation protocol lasted 36 days. During the first six days, as an adaptation phase, the participants followed a ramp protocol for supplement consumption until reaching

the desired dose. Thus, during the first two days, they consumed 5.5g of the fiber supplement, doubling the dose every two days until reaching the final dose of 22g per day. After the 6 days of adaptation, the participants consumed 22g per day for 30 days. During the supplementation period, the patients maintained their usual eating pattern, without receiving any intervention and/or dietary guidance.

Assessment of symptoms, biochemical tests, and intestinal microbiota composition

At the beginning and end of the period (T0 and T30), participants were assessed for the occurrence of gastrointestinal symptoms using the Gastrointestinal Symptom Rating Scale, which contains questions about the occurrence of gastrointestinal symptoms in the last 7 days [23] and also regarding the characteristics of the feces according to the Bristol Scale – a validated scale that contains photos of seven types of feces with precise descriptions of their appearance and consistency [24,25].

In order to detect possible changes in biochemical parameters related to inflammation, at the beginning and end of the study (T0-T30), analyses of the following biochemical parameters were performed: complete blood count (including erythrocyte sedimentation rate – ESR), glycemic profile (fasting blood glucose, fasting insulin + HOMA-IR and glycated hemoglobin), lipid profile (total cholesterol and fractions, triacylglycerols), liver profile (glutamic oxaloacetic transaminase – SGOT, glutamic pyruvic transaminase (SGPT), gamma-glutamyl transpeptidase (GGT), ferritin, homocysteine, uric acid, amylase, lipase, thyroid-stimulating hormone (TSH), triiodothyronine (T3), thyroxine (T4), cobalamin (B12), folic acid (B9), zinc (Zn), 25-hydroxyvitamin D (vitamin D), magnesium (Mg), protein C-reactive protein (CRP), fibrinogen and trimethylamine N-oxide (TMAO). To alleviate changes in stool pattern, digestive function, and intestinal health, the functional stool test was performed at T0 and T30.

RESULTS

Case 1 – Functional Constipation with Mild Inflammation and Good Clinical Response

A 32-year-old woman (BMI 23.7) with functional constipation reported irregular bowel movements and Bristol type 2 stools. After 30 days of fiber supplementation, she achieved daily bowel movements and improved stool form to Bristol type 3, accompanied by a reduction in abdominal distension and gas.

Stool analysis demonstrated a notable reduction in calprotectin (from 87 to <25 mcg/g) and zonulin (from 130 to 69 ng/mL), indicating reduced intestinal inflammation and improved gut barrier function. Fecal fat decreased from 20% to 10%, suggesting better lipid absorption. A marked increase in fecal histamine occurred without clinical symptoms, and a low elastase value likely reflected sampling variability rather than clinical insufficiency.

All hepatic, glycemic, thyroid, and inflammatory markers (CRP, ESR, liver enzymes, glucose, insulin, homocysteine, TSH) remained within normal ranges throughout the intervention. TMAO decreased from 2.9 to 1.8 μ M, suggesting possible modulation of the microbiota and reduced cardiometabolic risk.

Pancreatic elastase decreased from 174 to 25 mcg/g, a value consistent with exocrine insufficiency phenotype; however, no gastrointestinal symptoms were observed to corroborate this finding, suggesting possible analytical variability or pre-analytical error, although functional alteration cannot be ruled out.

Case 2 – Lifelong Constipation with Significant Gastrointestinal Improvement

A 37-year-old woman (BMI: 19.4 kg/m²) with long-standing constipation, infrequent bowel movements, and Bristol type 2 stool form. After supplementation, she reported increased bowel frequency to every other day, although stool form remained unchanged. She also described less effort to evacuate, reduced gas, and improved well-being.

Laboratory analysis revealed a substantial decrease in calprotectin (from 368 to 32 mcg/g), fecal fat (from >30% to 5%), and histamine (from high to 99 ng/g). These findings are consistent with reduced intestinal inflammation and enhanced digestive capacity. Zonulin remained stable (125 to 122 ng/mL), and pancreatic elastase increased from 398 to 636 mcg/g. TMAO rose from 1.6 to 4.8 μ M but remained within the expected range.

All other laboratory parameters, including liver enzymes, glycemia, insulin, CRP, ESR, and thyroid markers, were within normal ranges before and after the intervention.

Both cases demonstrated improved bowel patterns and favorable changes in functional stool markers, with stable metabolic, hepatic, and endocrine profiles, supporting the intervention's safety.

Table 1. Evolution of clinical, laboratory and coprological parameters after fiber supplementation (22g/day for 30 days)

Parameter	CASE 1		CASE 2	
	Pre	Post	Pre	Post
Bristol Scale	2	3 ↑	2	2
Evacuation Frequency	Irregular	Daily	Constipation	Alternate days
Calprotectin (mcg/g)	87	<25 ↓	368	32 ↓
Zonulin (ng/mL)	130	69 ↓	125	122 ↓
Pancreatic elastase (mcg/g)	174	25 ↓	398	636 ↑
Fecal fat (%)	20	10 ↓	>30	5 ↓
Fecal histamine (ng/g)	234	4437 ↑	-	99
TMAO (μM)	2.9	1.8 ↓	1.6	4.8 ↑
ESR (mm)	5	8 ↑	9	7 ↓
CRP (mg/dL)	0.03	0.03 →	0.03	0.03 →
Fasting glucose (mg/dL)	84	82 ↓	87	86 ↓
Fasting insulin (μU/mL)	6	4.1 ↓	9.8	7 ↓

↑ Increase | ↓ Decrease | → No change. TMAO: Trimethylamine N-Oxide.
ESR: Erythrocyte Sedimentation Rate. CRP: C-Reactive Protein

DISCUSSION

The human gut hosts trillions of bacteria, primarily from the Firmicutes and Bacteroidetes phyla, which interact with intestinal epithelial cells to exert metabolic, structural, and protective functions [26]. A balanced gut microbiota plays a fundamental role in modulating intestinal motility, immune function, and overall health [7,27].

In the present study, daily supplementation with 22 g of a prebiotic fiber mix (partially hydrolyzed guar gum and inulin) for 30 days was associated with improvements in bowel habits and gastrointestinal symptoms in both cases. Notably, participants achieved daily or alternate-day evacuation patterns, accompanied by improved stool consistency on the Bristol scale—features consistent with enhanced intestinal motility.

These clinical benefits are supported by the fermentative action of the fibers used: guar gum and inulin are prebiotic substrates that are metabolized by colonic bacteria, leading to the production of short-chain fatty acid (SCFAs), increased peristalsis, and pH modulation [4-6,28]. This mechanism aligns with the literature describing improved colonic transit and stool quality in constipated patients treated with these fibers [21,29].

Beyond symptom relief, the cases showed biochemical improvements, particularly reductions in calprotectin, zonulin, and fecal fat, markers indicative of lower intestinal inflammation and improved barrier function [30-32]. These

results suggest a potential role of fiber supplementation in the recovery of gut mucosal integrity, possibly mitigating features of leaky gut syndrome, which has been implicated in functional constipation [33].

Pancreatic elastase levels increased in Case 2, suggesting an enhancement in exocrine pancreatic function. This aligns with studies linking microbiota modulation to improved digestion and enzyme secretion [34].

The increase in TMAO in the Case 2 participant, although remaining within normal limits, highlights the complex interplay between microbial metabolism and host responses [10,35]. TMAO is a metabolite derived from microbial metabolism of dietary substrates and has been associated with cardiovascular risk, although its short-term fluctuations lack clinical relevance outside dietary context [9].

Systemic metabolic markers including glycemia, liver enzymes, TSH, and CRP remained within normal ranges for all participants, reinforcing the safety and local effects of the intervention on intestinal function.

From a functional perspective, this case series corroborates existing literature on the use of soluble prebiotic fibers as a safe and effective strategy for managing chronic constipation and restoring gut function [6,13,15,36-39].

LIMITATIONS

The small sample size (n=2) and short duration (30 days at full dose) limit generalizability and statistical inference. There was no dietary standardization, which may influence

stool and microbiota outcomes. Stool analyses reflect functional status but are subject to biological variability. Nonetheless, these findings offer valuable insights for hypothesis generation and future clinical trials.

CONCLUSION

This exploratory case series demonstrated that daily supplementation with a prebiotic fiber blend improved bowel habits and functional stool markers in adults with chronic constipation. The intervention was safe and well-tolerated, with stability in biochemical and metabolic markers. Larger controlled trials are warranted to validate these findings and elucidate underlying mechanisms.

AUTHOR'S CONTRIBUTION

V.A.S.R. and N.L. designed the study. V.M.R. and K.G. collected the data; A.B.B. wrote the paper and all authors critically reviewed the final manuscript.

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V.A.S.R. and N.L. are employees of Nestlé Health Science. The other authors have declared no conflicts of interest.

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SUPPLEMENTARY MATERIAL

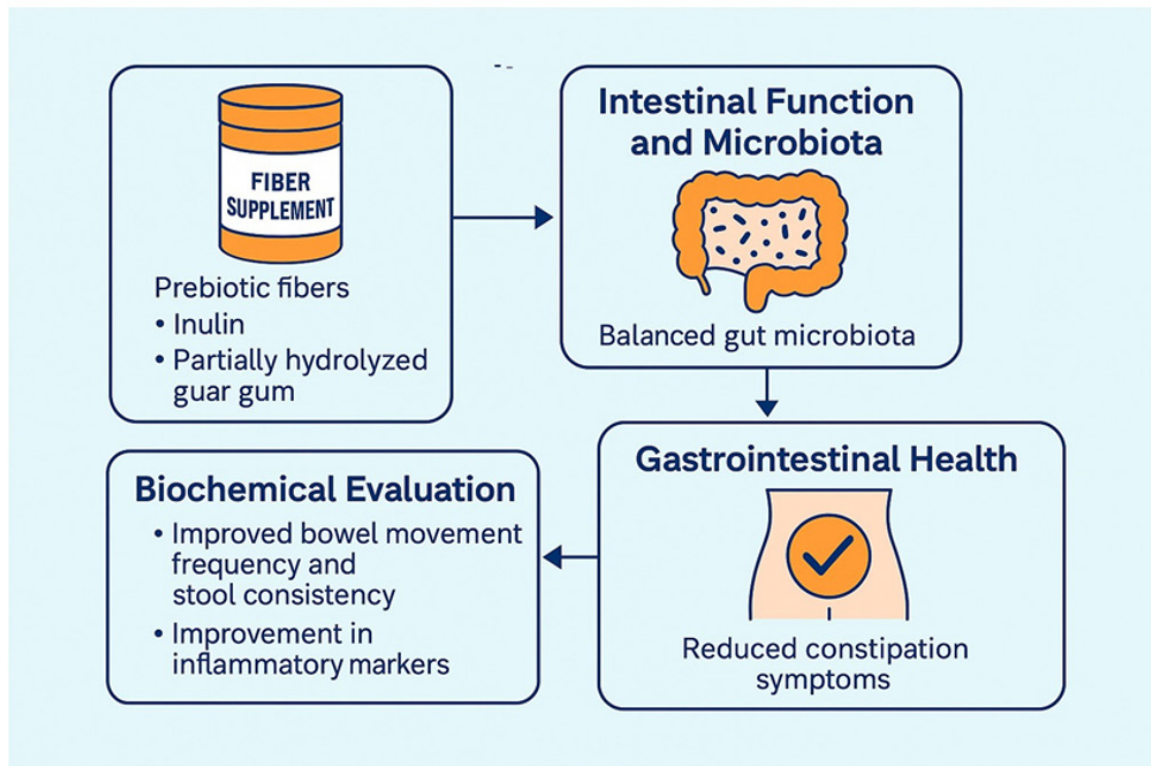


Figure. Fiber Supplementation and Gut Outcomes (graphical summary).